

Marked up Copies of Specifications

line illuminating units, each housing a light guide in a casing, in which the light guide is adapted to guide light from a light source incident from an end in the longitudinal direction and to scatter the light in light-scattering patterns which are formed along the longitudinal direction to emit this light from the emission plane, characterized in that
5 each line illuminating unit is arranged in such a manner that the light emitted from each emission plane of each light guide illuminates the same area of a document-reading surface, and the light guide casing has at least a part of its outside surface treated to control scattering and reflection of the light.

The line illuminating device according to the present invention is characterized
10 in that the light guide casing has at least a part of its outside surface covered by a member for controlling scattering and reflection the light.

Since at least a part of the outside surface of the light guide casing is provided with a coating film for controlling scattering and reflection of the light or is covered by the member for controlling scattering and reflection of the light, it is possible to prevent
15 the light scattered and reflected from the document surface from being scattered and reflected again at the light guide casing. With this, irradiation by the light scattered and reflected at the light guide casing on the document surface is eliminated. Accordingly, the original intensity distribution of the illuminating light is not disturbed by the scattered and reflected light from the light guide casing and as a result, an image can be
20 clearly read.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction
25 with the accompanying drawings.

Fig. 1 is a perspective view of a line illuminating device according to a first embodiment of the present invention;

Fig. 2 is a cross-sectional view of a document-reading device incorporating the line illuminating device as shown in Fig.1;

30 [Fig. 3 is a graph] showing distribution of light intensity in a main-scanning direction in a document-reading surface;
-- Fig. 3(a), 3(b) and 3(c) are graphs --

[Fig. 4 is a graph] showing spatial distribution of light intensity in a sub-scanning direction;
-- Fig. 4(a) and 4(b) are graphs --

Fig. 5 is a cross-sectional view of a document-reading device incorporating a line illuminating device (a line illuminating device provided with two illuminating units with a casing) according to a second embodiment of the present invention;

5 ~~Fig. 6 is a cross-sectional view of a line illuminating device according to a third embodiment of the present invention;~~
 ~~-- Fig. 6(a), 6(b) and 6(c) are cross-sectional views --~~

~~Fig. 7 is a perspective view of the line illuminating device according to the third embodiment of the present invention;~~
 ~~-- Fig. 7(a) and 7(b) are perspective views --~~

~~Fig. 8 is a cross-sectional view of a line illuminating device according to a fourth embodiment of the present invention;~~
 ~~-- Fig. 8(a), 8(b) and 8(c) are cross-sectional views --~~

10 ~~Fig. 9 is a cross-sectional view of a line illuminating device according to a fifth embodiment of the present invention;~~
 ~~-- Fig. 9(a), 9(b) and 9(c) are cross-sectional views --~~

Fig. 10 is a cross-sectional view of a contact-type image sensor to which a line illuminating device according to a sixth embodiment of the present invention is applied;

15 Fig. 11 is a perspective view of the line illuminating device according to the sixth embodiment of the present invention;

~~Fig. 12 is a view showing an arrangement of light-scattering patterns and distribution of light intensity in the line illuminating device according to the sixth embodiment of the present invention;~~
 ~~-- Fig. 12(a), 12(b) and 12(c) are views --~~

20 ~~Fig. 13 is a perspective view of a line illuminating device according to a seventh embodiment of the present invention;~~
 ~~-- Fig. 13(a), 13(b) and 13(c) are perspective views --~~

Fig. 14 is a view showing another arrangement example of the light-scattering patterns;

Fig. 15 is a view showing yet another arrangement example of the light-scattering patterns;

25 Fig. 16 is a view showing a problem of a line illuminating device in which two line illuminating units are oppositely arranged, wherein only one line illuminating unit is lighted;

Fig. 17 is a graph of light intensity characteristics in a condition without a document in the line illuminating device as shown in Fig. 16;

30 Fig. 18 is a graph of light intensity characteristics in a condition with a white document in the line illuminating device as shown in Fig. 16;

~~Fig. 19 is a view showing an output signal when a document with a black rectangular area is read in the line illuminating device as shown in Fig. 16;~~
 ~~-- Fig. 19(a) and 19(b) are views --~~